Enhancing Coastal and Ocean Observing and Innovation: OAR and IOOS

Image: High-performance computers are crucial tools for weather and climate forecast models; Source

Cloud Computing and Artificial Intelligence

OVERVIEW

Cloud services represent a transformative technology that can improve many of Oceanic and Atmospheric Research (OAR) and Integrated Ocean Observing System (IOOS) functions—observations, data management, forecasting, and end-user products and applications—to better serve the public. Shifting to cloud computing and implementing Artificial Intelligence (AI) strategies will better unlock the full utility and potential of NOAA, OAR, and IOOS' massive and diverse data.

Reflective of OAR's and IOOS' diverse missions, the available ocean and Great Lakes data is vast, complex, non-standardized, and distributed—and the systems and infrastructure that process, store, and disseminate these data are just as complex. Additionally, the volume and variety of OAR's and IOOS' ocean and Great Lakes data are expected to increase with the deployment of new observing systems and the increase of data-acquisition capabilities.

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OPPORTUNITY

Enhancing OAR and IOOS observational, research, and operational collaborative efforts will allow for the development and implementation of a cohesive cloud and data strategy that will: 1) drive innovation and guide advancements in science, products and services; 2) accelerate the implementation of the most effective science and technology applications; and, 3) scale the infrastructure and services needed to support this growth. Implementing standardized strategies across organizations is challenging and a priority outcome of these workshops is advancing specific recommendations to forward these goals.

Priority topics:

- Leverage cloud computing as connector across organizations, especially for data quality assessment/ quality control (QA/QC). Cloud, artificial intelligence, and machine learning (ML) services can serve to connect different government agencies and external partners, and support the increasing demand for data across different platforms and datasets.
- Establish protocols for IOOS-OAR collaborations (e.g., protocols for Zarr, a storage format which makes large datasets easily accessible to distributed computing).
- Develop consistent cloud terminology and cloud vendors across IOOS and OAR.
- Develop a list of high-priority needs and identify the strongest overlap between IOOS and OAR that would be best targeted by cloud computing and AI/ ML approaches.
- Improve access to variables that support interpreting ocean acidification and hypoxia impacts, particularly biology.
- Identify needs and applications for which edge processing is most fitting.
- Publicize a grand prize with a tiered prize structure for the AI community to effectively and efficiently leverage external expertise to generate innovative solutions for key problems. For an example, see the IOOS Southern California Coastal Ocean Observing System (SCCOOS) participation in a challenge with computer science graduate students at the University of California San Diego.

NEXT

Near-term recommendations (0-1 years)

- Drive expanded use of cloud computing by developing an OAR-IOOS Cloud Community of Practice that focuses on:
  - Explore new cloud-hosted data formats (e.g., Zarr).
  - Identify ways cloud hosting would speed development and integration of new circulation models by both OAR and IOOS cloud service providers preferences.
  - Determine new services that are needed on cloud service providers and work with providers to deploy these services.
  - Advance IOOS and OAR efforts around acoustic ocean data.
- Enhance the use of best practices and expand opportunities for IOOS-OAR collaboration, via seminars on cloud projects, virtual coffee hours, working groups, postdoctoral positions, NOAA rotational program positions, and internships for undergraduate scholars.
- Explore how OAR may better leverage the IOOS coastal cloud sandbox.
- Ensure that IOOS and OAR cloud computing and AI efforts are aligned to collaboratively target priority stakeholder and scientific needs.
- Ensure that IOOS and OAR personnel participate in NOAA-wide cloud technical, scoping, and governance efforts to ensure that key needs and workflows are represented

Mid-term recommendations (2-5 years)

- Increase IOOS and OAR understanding of cloud-hosted applications by supporting joint funding opportunities (e.g., grants or prize competitions).
- Focus on developing specific and complementary cloud services via code sprints or other joint development projects.
- Monitor the development of other communities of practice to continuously improve and implement best practices developed in these communities.

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